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Distal suprascapular nerve block—do it yourself: cadaveric feasibility study

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Background: A bone landmark–based approach (LBA) to the distal suprascapular nerve (dSSN) block is an attractive ‘‘low-tech’’ method available to physicians with no advanced training in regional anesthesia or ultrasound guidance. The primary aim of this study was to validate the feasibility of an LBA to blockade of the dSSN by orthopedic surgeons using anatomic analysis. The secondary aim was to describe the anatomic features of the sensory branches of the dSSN.
Materials and methods: An LBA was performed in 15 cadaver shoulders by an orthopedic resident. Then, 10 mL of methylene blue–infused 0.75% ropivacaine was injected around the dSSN; 2.5mL of red latex solution was also injected to identify the position of the needle tip. The division and distribution of the sensory branches that originate from the suprascapular nerve were described.
Results: The median distance between the dSSN and the site of injection was 1.5 cm (0-4.5 cm). The most common injection site was at the proximal third of the scapular neck (n = 8). Fifteen dSSNs were stained proximal to the origin of the most proximal sensory branch. All 15 dSSNs gave off 3 sensory branches that innervated the posterior glenohumeral capsule, the subacromial bursa, and the coracoclavicular and acromioclavicular ligaments.
Conclusions: An LBA for anesthetic blockade of the dSSN by an orthopedic surgeon is a simple, reliable, and accurate method. Injection close to the suprascapular notch is recommended to involve the dSSN proximally and its 3 sensory branches.
Level of evidence: Anatomy Study; Cadaver Dissection

Keywords: Cadaver; pain; regional anesthesia; shoulder; subacromial bursa; suprascapular nerve; unguided block

Institutional Review Board approval was not required for this study.

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The suprascapular nerve (SSN) is a major mixed motor and sensory nerve that provides sensory innervation to the posterior and superior aspects of the shoulder. Regional anesthesia obtained by the distal SSN (dSSN) block is widely used in the management of acute, chronic, and recalcitrant shoulder pain.[26] Renewed interest in this technique has arisen in an effort to avoid other therapeutic options (anti-inflammatory drugs and intra-articular steroid injections) for postoperative analgesia after shoulder surgery.[2,3,10,29]

The dSSN block was initially described by Wertheim and Rovenstein in 1941 and consisted of an injection of 10 mL of local anesthetic directly into the suprascapular notch.[6,32] Since its description, the technique has undergone multiple modifications, including the use of additional equipment.[2,13] Image guidance with ultrasound has most recently been implemented in an attempt to improve the accuracy of regional anesthesia (eg, femoral, sciatic, or supraclavicular anesthetic block).[11,14,21]

A landmark-based approach (LBA) for dSSN block appears to be an attractive method available to physicians with no advanced training in regional anesthesia or ultrasound guidance.[24] We speculate that most orthopedic surgeons could reliably perform dSSN block using familiar anatomic landmarks.

The primary aim of our study was to validate the feasibility of an LBA to the dSSN by orthopedic surgeons using anatomic analysis. The secondary aim was to verify the site of solution injection at the suprascapular notch using characterization of the involved branches of the SSN. Relevant hypotheses were that an LBA to dSSN block by orthopedic surgeons would lead to reliable and accurate analgesic injection.

Materials and methods

Fifteen shoulders from 8 fresh frozen cadavers were included. The median age of the specimens (2 men, 6 women) was 82 years (74-98 years) with a median body mass index (BMI) of 24 kg/m^2 (range, 18.8-30.1 kg/m^2). A history of irradiation to the brachial plexus or shoulder surgery and trauma in the cervical, scapular, supraclavicular, or shoulder girdle area were exclusion criteria. None of the specimens were excluded.

LBA for posterosuperior block of the dSSN

An orthopedic resident (L.B.) with no experience in regional anesthesia marked 15 dSSNs at the suprascapular notch on the basis of bone landmarks about the shoulder. The protocol for LBA to the dSSN, previously described by Matsumoto et al,[19] was defined a priori and used for all 15 procedures. It consisted of a direct posterolateral SSN block.[9] The operator was positioned behind the shoulder. The superficial anatomy of the shoulder was identified, and the skin was marked to outline the clavicle, the scapula including the acromion, and the coracoid process (Fig. 1). The insertion point was at the midpoint of the anterolateral angle of the acromion and the medial edge of the scapular spine. The needle was inserted at a 30° angle posterior in the sagittal plane until it reached the base of the coracoid process. An injection of 10 mL of 0.75% ropivacaine colored with 3 drops of methylene blue was performed in all 15 cases; 2.5 mL of red latex solution was also introduced to determine the needle tip's position.

Figure 1 Superior view of the shoulder. The needle was inserted at the midpoint of the anterolateral angle of the acromion (*A*) and the medial edge of the scapular spine (*Ss*). The needle was inclined 30° posteriorly in the sagittal plane and inserted until it reached the base of the coracoid process (*). *C*, clavicle.

Dissection after injection of the dSSN using an LBA

Shoulder dissection

To assess the effectiveness of the LBA to the dSSN block, cadaveric dissection of the dSSN and its sensory branches was performed; description of the anatomy of each specimen was also performed. The trapezius, deltoid, and pectoralis major muscles were removed with the proximal third of the clavicle and the scapular spine. The supraspinatus and infraspinatus muscles were reflected laterally from their scapular origins; they were then transected 3 cm from their insertion on the greater tuberosity of the humerus. The superior transverse scapular ligament was systematically preserved; the spinoglenoid ligament was resected. Microsurgical instruments and surgical loupes (3.5× magnification) were used to dissect the dSSN and its sensory branches. The mesoneurium was not preserved.

Accuracy and reliability of the LBA for dSSN block

The accuracy of the LBA was evaluated by using the position of the needle tip (red latex solution) with respect to the dSSN at the suprascapular notch. The position of the needle tip was defined, for the purposes of this study, as the site of injection. Predicted LBA block efficacy was assessed by staining of the dSSN at the suprascapular notch as well as of its sensory branches and the distance between the origin of each sensory branch and the needle tip (Fig. 2).

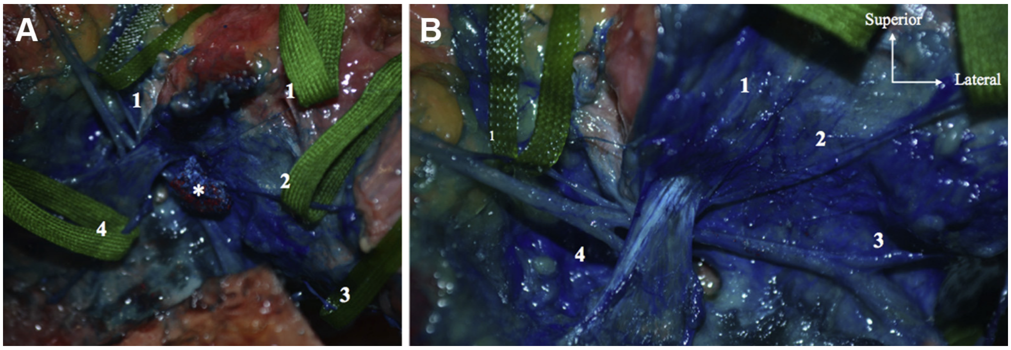

Figure 2 Posterior view of the shoulder in cadaver specimen No. 4. (**A**) Marking of the distal suprascapular nerve at the scapular neck (*) through a landmark-based approach with local anesthetic and methylene blue dye. (**B**) The distal suprascapular nerve at the suprascapular notch, the medial (*1*) and lateral (*2*) subacromial branches, and the posterior glenohumeral branch (*3*) were dyed with methylene blue; *4*, branch to supraspinatus muscle.

Anatomic description

The number of SSN branches and their respective courses were described. The distance between the origin of the branches and the dSSN at the suprascapular notch was also measured. Distances were measured with a caliper.

Statistical analysis

Continuous variables were described using medians and ranges and categorical variables with frequencies and proportions. Qualitative values were compared by the Fisher exact test. Quantitative values were compared using the Mann-Whitney *U* test. A multiple regression model was used to assess for correlations between BMI and accuracy (distance from needle tip to SSN at the suprascapular notch). Adjustments were performed on the basis of age and sex. Statistical analyses were performed using Excel (Microsoft, Redmond, WA, USA) and XLSTAT 2011 (Addinsoft SARL, Paris, France) software packages. Confidence intervals were fixed at 95%, and the level of statistical significance was set at .05.

Results

Accuracy of the dSSN block

The median distance between the dSSN at the suprascapular notch and the site of injection was 1.5 cm (range, 0-4.5 cm). The needle tip was distal to the suprascapular notch in all 15 cadaver shoulders (100%); the most common injection site was at the proximal third of the neck of the scapula (n = 8 [53%]) (Fig. 2). Cadaver BMI (coefficient (ß), 0.625; 95% confidence interval, −1.42 to 2.67; $P = .516$) had no impact on accuracy (ie, distance of the needle's tip to the dSSN at the suprascapular notch) regardless of age and sex.

Predicted efficacy of the dSSN block

The dSSN at the level of the suprascapular notch and its sensory branches were stained in 15 of 15 cadaver shoulders (100%) (Figs. 2 and 3). Fifteen dSSNs were stained proximal to the origin of the most proximal sensory branch. Dispersion of the colored solution was limited to the supraspinous fossa and the suprascapular and subacromial areas; no methylene blue was found in the infraspinous fossa. No other nervous structures were stained (eg, axillary nerve, supraclavicular or infraclavicular brachial plexus); no cases of intravascular injection were noted. Data are summarized in Table I.

Anatomic description of the shoulder

The 15 dSSNs passed through the suprascapular notch and under the superior transverse scapular ligament. Three sensory branches were identified for all 15 (100%) dSSNs dissected (Fig. 4): the medial subacromial (MSA) branch, the lateral subacromial (LSA) branch, and the posterior glenohumeral (PGH) branch; 2 LSA branches were identified in 2 (13.3%) cadaveric shoulders. The origin of the MSA and LSA branches diverged at 1.7 cm (range, 0-2.5 cm) and 0 cm (range, 0-1.4 cm), respectively. The origin of the MSA branch was most commonly (n = 13 [87%]) proximal to the suprascapular notch, whereas the origin of the LSA branch was most frequently (n = 12 [80%]) identified at the level of the suprascapular notch. The MSA branch turned superolaterally around the base of the coracoid process, giving off branches to the coracoclavicular ligaments (ie, conoid and trapezoid ligaments; n = 15 [100%]), then ran superolaterally toward the medial pole of the subacromial bursa (n = 15 [100%]). The LSA branch was situated at the deep interval between the supraspinatus and infraspinatus muscles before running over the superior face to the supraspinatus tendon and giving off a sensory branch to the LSA pole regardless of the number of branches. No LSA sensory branch to the supraspinatus tendon was identified. The LSA and MSA branches provided bipolar sensory innervation to the subacromial bursa in all 15 (100%) cadaveric shoulders (Fig. 4). The origin of the PGH branch was at a median distance of 2.9 cm (range,

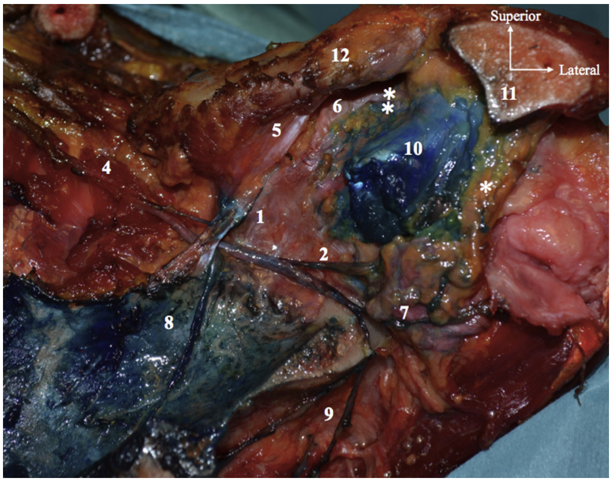

Figure 3 Posterior view of the shoulder. The medial (*1*) and lateral (*2*) subacromial branches (*3*) from the distal suprascapular nerve (*4*) provide bipolar sensory innervation through multiple rami to the medial (**) and lateral (*) poles of the subacromial bursa; *5*, conoid ligament; *6*, trapezoid ligament; *7*, posterior glenohumeral branch; *8* and *9*, branches to supraspinatus and infraspinatus muscles; *10* supraspinatus muscle; *11*, acromion; *12*, clavicle.

1.8-5.2 cm) distal to the suprascapular notch; no origin of the PGH branch was reported proximal to the suprascapular notch. Distal to the spinoglenoid notch, the PGH branch ran inferomedially toward the posterior shoulder capsule. The anatomic features of the dSSN and its sensory branches are summarized in Figure 4.

Discussion

This study confirmed the primary and secondary hypotheses. LBAs performed by an orthopedic surgeon allowed reliable and accurate marking of 100% of the dSSNs and their sensory branches.

Implementation of this technique as one branch in a multimodal approach to the treatment of perioperative, chronic, and recalcitrant shoulder pain has the potential to significantly reduce the use of narcotic pain medication.[4,6,12,22,26,27,33] Anesthetic block of the dSSN is widely used by clinical professionals including rheumatologists, neurologists, and pain specialists.[5] By avoiding phrenic nerve palsy and associated hemidiaphragmatic paresis, the dSSN block is also an alternative to interscalene brachial plexus blocks for the management of postoperative pain after shoulder surgery.[34] Thus, dSSN block is of significant interest in certain high-risk populations with restrictive pulmonary insufficiency, especially overweight and elderly patients.[30]

In this study, the distance (1.5 cm; range, 0-4.5 cm) between the site of injection and the SSN at the suprascapular notch supports the use of the LBA as a guidance method, even among those without experience in regional anesthesia. The method chosen for this study was a posterolateral, direct SSN block,[9] initially described and validated by Matsumoto et al.[19] The dSSN anesthetic block was initially described by Wertheim and Rovenstine[32] in 1941 for patients with chronic shoulder pain. Since its description, SSN block has undergone several

Table I Results of marking of the distal suprascapular nerve at the suprascapular notch through a landmark-based approach in cadaver specimens

Specimen No. and side	Age (yr)	BMI (kg/m^2)	Site of injection	Distance needle/ SSN at SS notch (cm)	Distance needle/ origin of sensory branches of dSSN (cm)			Staining with colored anesthetic solution			
					MSAb	LSAb	PGHb	SSN at SS notch	MSAb	LSAb	PGHb
1 Right	87	26.1	SS fossa	2.6	3.7	2.6	4.0	Yes	Yes	Yes	Yes
2 Left	87	26.1	Scapular neck	1.8	3.8	1.8	0.5	Yes	Yes	Yes	Yes
3 Left	74	23.8	Scapular neck	2.5	4.3	1.2	2.3	Yes	Yes	Yes	Yes
4 Right	74	23.8	Scapular neck	1.7	1.7	0	1.2	Yes	Yes	Yes	Yes
5 Left	82	30.1	Scapular neck	1.2	2.5	1.2	1.0	Yes	Yes	Yes	Yes
6 Left	82	30.1	Scapular neck	2.1	3.1	2.1	2.6	Yes	Yes	Yes	Yes
7 Right	98	18.8	Coracoid base	0.6	1.3	0.6	1.2	Yes	Yes	Yes	Yes
8 Left	98	18.8	Scapular neck	1.4	2.6	1.4	0.5	Yes	Yes	Yes	Yes
9 Right	90	18.8	Coracoid base	0.5	1.7	0.5	2.3	Yes	Yes	Yes	Yes
10 Left	90	18.8	SS notch	0	2.3	0	3.2	Yes	Yes	Yes	Yes
11 Left	77	24	SS fossa	3.3	5.1	3.3	3.0	Yes	Yes	Yes	Yes
12 Right	77	24	Scapular neck	1.5	1.5	0.4	1.5	Yes	Yes	Yes	Yes
13 Left	82	26.7	SS fossa	1.4	2.1	1.4	2.7	Yes	Yes	Yes	Yes
14 Right	82	26.7	SS fossa	4.5	5.1	4.5	2.3	Yes	Yes	Yes	Yes
15 Left	83	26.6	Scapular neck	1.0	3.0	1.0	2.2	Yes	Yes	Yes	Yes

BMI, body mass index; *SSN*, suprascapular nerve; *SS*, suprascapular; *dSSN*, distal suprascapular nerve; *MSAb*, medial subacromial branch; *LSAb*, lateral subacromial branch; *PGHb*, posterior glenohumeral branch.

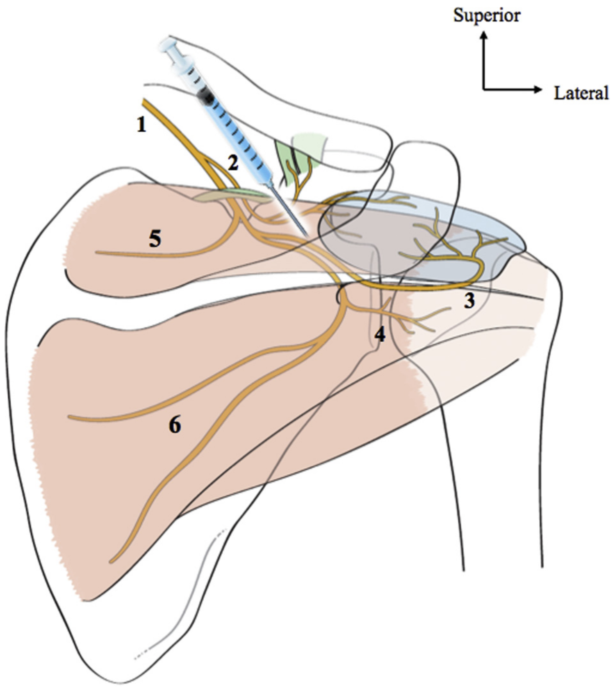

Figure 4 Schematic diagram of the ideal injection site—suprascapular notch, base of coracoid, or scapular neck—to obtain optimal marking of the distal suprascapular nerve (*1*) and its sensory branches. The branches provide innervation to the subacromial bursa (*blue*) through the medial (*2*) and lateral (*3*) subacromial branches, posterior glenohumeral capsule through the posterior glenohumeral branches (*4*), and coracoclavicular ligaments (*green*) through the medial subacromial branch (*2*); *5* and *6*, branches to supraspinatus and infraspinatus muscles.

modifications, such as needle insertion site, access modality, and use of additional equipment.[9] Many differing approach techniques have been described, taking into account the point of needle insertion in relation to the anatomic landmarks about the shoulder. They can be direct or indirect, depending on whether the anesthetic solution is administered in the suprascapular notch or in the floor of the suprascapular fossa.[5,9]

A detailed anatomic description was also needed to assess the role of the SSN with respect to sensory innervation of the shoulder, therefore the interest in performing dSSN block. There has been significant debate in the literature with regard to the anatomic features of the sensory divisions of the SSN. Horiguchi[15] cited Yamada as the first to describe a subacromial branch in 1968, referring to it as nervus cutaneus subacromialis. Aszmann et al[1] described this branch as an articular branch that innervated both the coracoclavicular ligaments and subacromial bursa. Vorster et al[31] supported this finding and therefore proposed to rename the branch nervus suprascapularis ramus articularis. Eckmann et al[8] described articular branches coursing laterally toward the PGH joint and head of the humerus and then piercing the fascia overlying the head of the humerus to innervate the PGH capsule and subacromial bursa, respectively. In this study, we report new features of the sensory branches of the dSSN, including 3 branches: an MSA branch, an LSA branch (2 in 13.3% specimens), and a PGH branch (Fig. 4). This description is consistent with the bipolar division of the nociceptors in the medial and lateral part of the subacromial bursa described by Ide et al.[16] Vorster et al[31] found that all sensory branches arose proximal to the suprascapular notch in 30% of cases; our study produced similar results (28.9%), with the additional caveat that all branches consisted solely of the MSA branch.

The most proximal sensory branch (ie, MSA branch) was located 2.5 cm from the suprascapular notch, and no branch proximal to the transverse suprascapular ligament traveled outside of the suprascapular notch. Given the high level of anatomic variation of the suprascapular notch and the limited size of our cadaver sample, the possibility that proximal sensory branches may exist outside the suprascapular notch must be considered. We therefore recommend injection of anesthetic >2.5 cm proximal to the entrance of the SSN at the suprascapular notch; injection performed at the distal-lateral aspect of the suprascapular notch through the LBA provided satisfactory diffusion of anesthetic products (Figs. 2 and 3).

The development of high-frequency ultrasound probes and high-definition ultrasound machines has had a significant impact on the efficiency of anesthetic blockade of superficial nerves in addition to the brachial plexus. Whereas an LBA by an orthopedic resident not familiar with ultrasound guidance (L.B.) allowed excellent results for the dSSN anesthetic block, the ultrasound-guided technique must first be mastered to obtain satisfactory results.[5,17,18,23,25] The direct LBA is a simple and reliable method for blockade of the dSSN while also being accessible to orthopedic surgeons and in line with the "do it yourself" ideology proposed by Sherman.[24] This study supports surgeons' ability to "take back the block,"[24] especially given data to support the fact that the accuracy obtained with this technique is not affected by BMI. Thus, we hypothesize that an LBA to the dSSN block could feasibly be performed by surgeons in the anesthetized patient preoperatively or postoperatively.

This study is subject to the inherent biases associated with cadaveric studies. Furthermore, the limited number of specimens decreases the reliability of descriptive and analytic statistics.[20,28] A single orthopedic surgery resident performed all of the dSSN blocks in this study; therefore, intraclass correlation could not be calculated. Pleuropulmonary injuries, systemic toxicity, and peripheral nerve injury are classic complications of SSN anesthetic blocks; however, these were not evaluated in the study. In an effort to reduce the risk of intravascular injection, we recommend drawing back on the plunger before injection. The cadaver dissection step may have modified the normal anatomy, the needle's positioning, or the solution's spreading, which may have distorted the study's findings. The volume of solution to injectate was based on the recommendations of Desroches et al[7]; however, excessive dispersion of the staining dye may have increased the chance that the dSSN was marked.

Conclusion

Data herein suggest that the LBA for anesthetic blockade of the dSSN by an orthopedic surgeon is a simple, reliable, and accurate method. We recommend injecting close to the suprascapular notch to involve the dSSN proximally as well as the 3 sensory branches, ensuring analgesia about the coracoclavicular ligaments, the subacromial bursa, and the PGH joint capsule. Further studies are needed to determine the safety and analgesic effectiveness of this method when it is performed by an orthopedic surgeon.

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Disclaimer

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